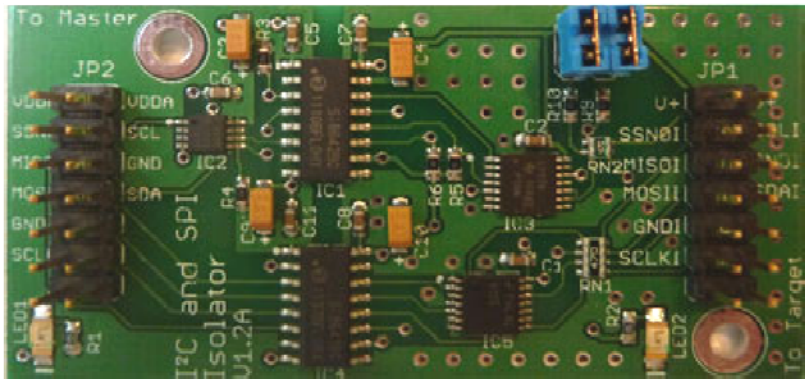
I2C and SPI Isolation and Level Shifting

Hardware User's Manual



http://www.i2ctools.com/

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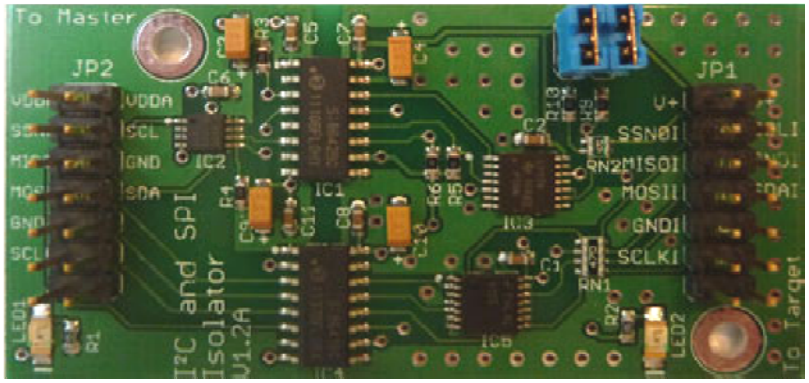
DISCLAIMER AND WARRANTY

Proper use of I2C and SPI Isolator and level shifter is the sole responsibility of the user. SB Solutions, Inc. is not responsible for any damage resulting from misuse or improper installation.

SB Solutions, Inc. will, at our option, repair or replace a defective I2C and SPI Isolator and Level Shifter hardware within thirty (30) days of the purchase date. Return shipping is the responsibility of the user.

INTRODUCTION

The Isolator incorporates high-speed digital isolators rated at 3.75 kV_{RMS}. In addition to the voltage isolation, level shifting of I2C and SPI signals is possible. The USB-to-I2C hardware operates at 3.3V, however, using this hardware, allows the user to connect I2C and SPI voltages ranging from 2.5V to 5.5V.



There are two LEDs located on the hardware. Each side of the isolator requires a separate supply; the LEDs indicate that the voltage sources are applied to the hardware.

The following bi-directional I2C signals are available isolated and level shifted:
SDA – I2C data in and out
SCL – I2C clock signal

The following unidirectional SPI signals are isolated and level shifted:
SSN – Slave Select (chip select) – is an output signal from the isolation hardware
MISO – Master In; Slave Out – is an input signal to the isolation hardware
MOSI – Master Out; Slave In – is an output signal from the isolation hardware
SCLK – Master Serial Clock – is an output signal from the isolation hardware

Note that other IO features and voltage sources available on the USB-to-I2C hardware are not available on the Isolator hardware.

I2C AND SPI ISOLATOR AND LEVEL SHIFTER CONTENTS

- ✓ I2C and SPI Isolation and Level Shifting hardware

GETTING STARTED

Assumptions

We are assuming the user of this product has experience with the I^2C Bus protocol. The I^2C Bus specification is a good source of detailed information about the I^2C Bus. The complete specification can be downloaded from the NXP Semiconductors website.

Static Handling Precautions

The I2C and SPI Isolation and Level Shifting hardware contains CMOS devices that can be damaged by ESD. It is recommended to use a ground strap or touching the PC case or other grounded source before unpacking or handling the Isolator Hardware.

MINIMUM REQUIREMENTS

- ✓ USB-to-I2C Professional or USB-to-I2C Elite installed on a Windows PC

ISOLATOR AND LEVEL SHIFTER SUPPLY VOLTAGE REQUIREMENTS

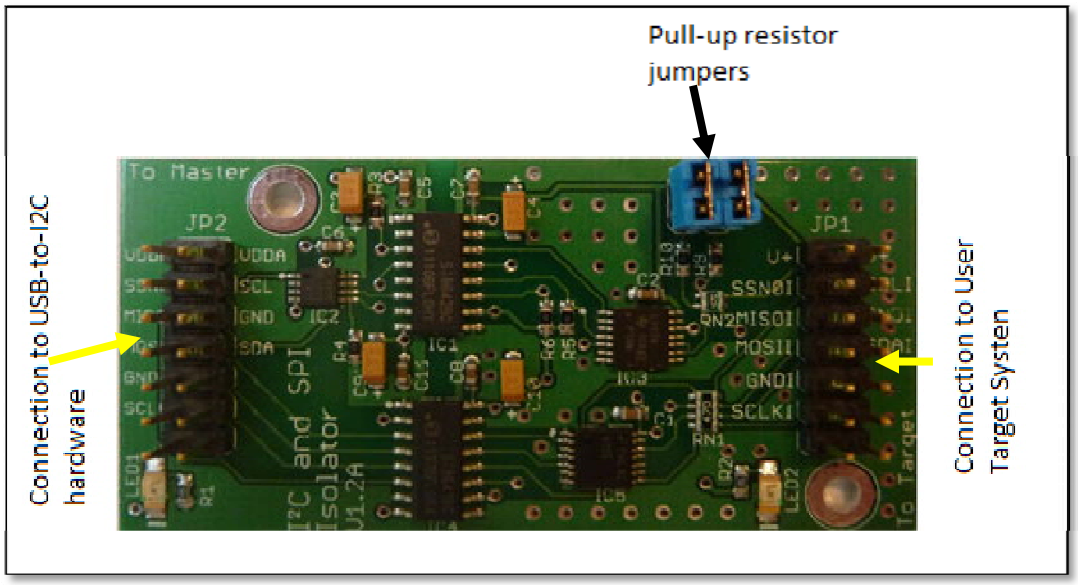
The I2C Isolator and Level Shifter derives its power on the Master side from the USB-to-I2C hardware. This is a 3.3V supply.
The target side must be supplied by the target application. Do not use a common ground or supply voltages as this will defeat the function of the isolator. Each side must use its own supply voltage and ground.

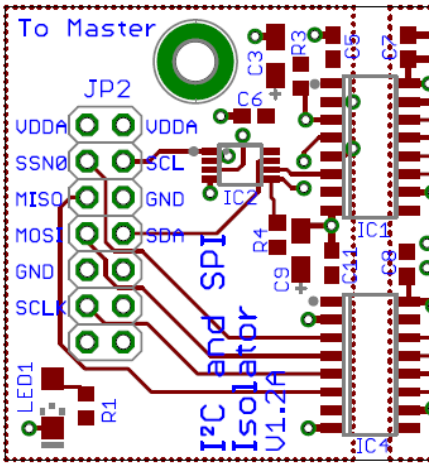
INSTALLATION

- The I2C and SPI Isolator and Level Shifter hardware connects directly to the 14-pin ribbon cable from the USB-to-I2C Professional hardware.
- If using USB-to-I2C Elite, the 18-pin split cable will require that you connect each individual colored wire to its appropriate connection on the Isolator and Level Shifter hardware
- The target side of the hardware requires that you connect a supply voltage equal to the voltage of the I2C/SPI hardware you are communicating with
- Note that the Isolator and Level Shifter hardware only brings out a subset of the connections from the USB-to-I2C hardware

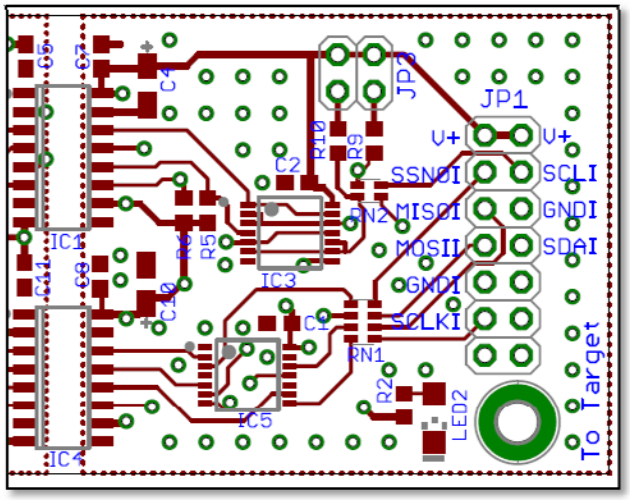
HARDWARE DESCRIPTION

A picture of the isolator is shown below. The left side of the board is connected to the USB-to-I2C hardware. The left side is also powered directly by the USB-to-I2C hardware. LED1 on the bottom left side of the board will illuminate when it is connected and powered by the USB-to-I2C hardware.
The right side of the board is powered by the user target hardware. Power can be applied to either of the V+ pins on header JP1. The V+ voltage can be in the range of 2.5V to 5.5V. Note that the right side of the board should not be powered from the USB-to-I2C hardware, as this would defeat the isolation properties.
There are 3.3kOhm pull-ups to V+ on the I2C lines. These can be disconnected from the circuit by removing the pull-up jumpers.

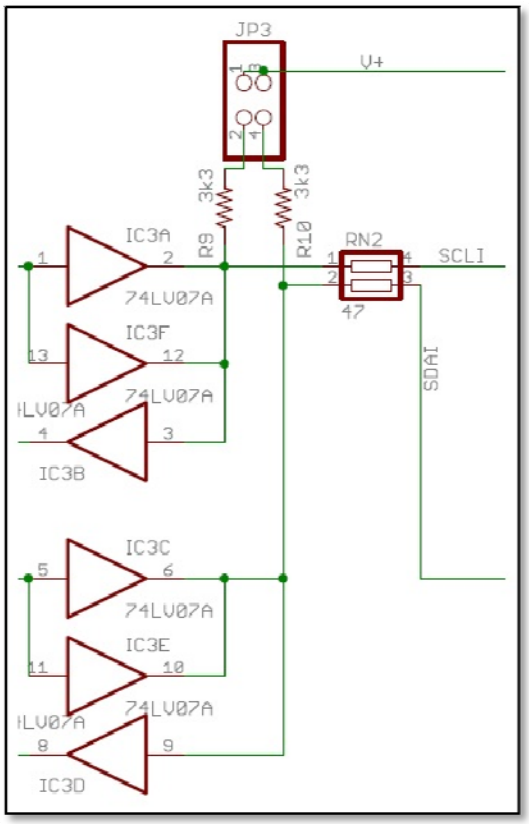




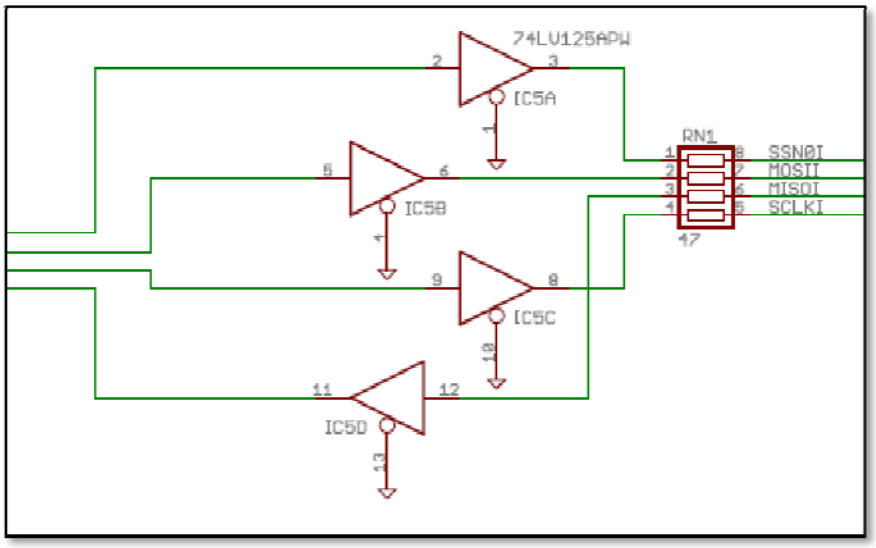
The figure to the left shows the layout of the side of the board that is connected to the USB-to-I2C hardware.
There are no pull-ups on the left side of the board, so the pull-up jumpers on the USB-to-I2C hardware should be used.
LED1 illuminates when the left side of the board is powered by the USB-to-I2C hardware.
The signals from the USB-to-I2C hardware are limited to the following SPI signals: SSN (or Chip Select), MISO, MOSI, and SCLK; as well as the following I2C signals: SCL (serial clock) and SDA (serial data).



The figure to the left shows the layout of the side of the board that is connected to the user's target hardware.
There are pull-ups on the right side of the board. These can be removed from the circuit by removing the jumpers at JP3. LED2 illuminates when the right side of the board is powered by the user's hardware.



I2C Interface Schematic
The I2C signals are driven by 74LV07A logic gates. The logic gates are powered by the V+ voltage. There are 3.3kOhm pull-up resistors to V+, and 47 Ohm series resistors. Use JP3 to remove/insert the pull-up resistors into the circuit.



SPI Interface
The SPI signals at the target connector are applied to the isolation circuit through 74LV125A logic buffers and 47 ohms series resistors. The circuit is shown here.

I2C Port Electrical Characteristics

Maximum I2C clock (SCL):	**400 kHz**
Vil Low level input voltage:	**0.3*V+ (max)**
Vih High level output voltage:	**0.7*V+ (min)**
Iol Low level output current:	**16mA max @ V+ =4.5-5.5V**
	8mA max @ V+ =3.0-3.6V
	4mA max @ V+ =2.5-2.7V
Vi Input Voltage	**5.5V max**
Ci Input Capacitance	**3.0pF max**

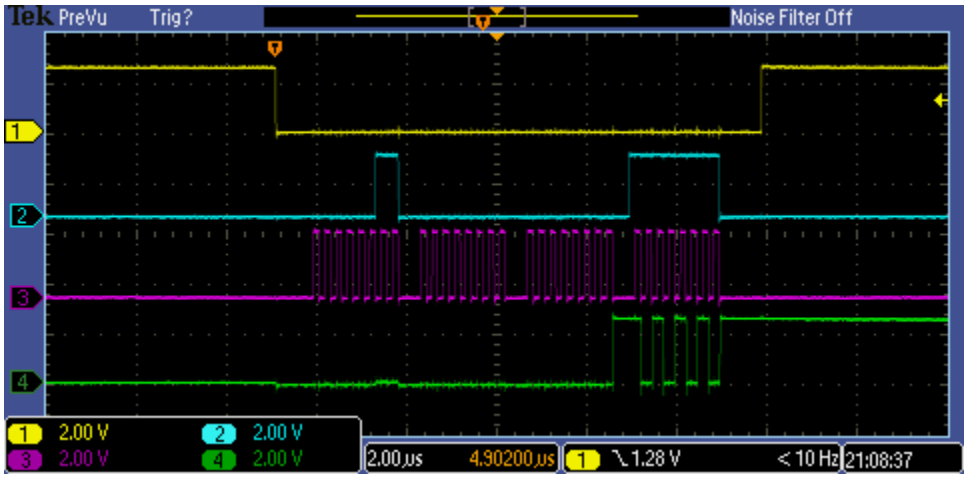
SPI Port Electrical Characteristics

Maximum Serial Clock (SCLK):	**6.0 MHz**
Vil Low level input voltage:	**0.3*V+ (max)**
Vih High level output voltage:	**0.7*V+ (min)**
Iol Low level output current:	**16mA max @ V+ =4.5-5.5V**
	8mA max @ V+ =3.0-3.6V
	2mA max @ V+ =2.5-2.7V
Ioh High level output current:	**-16mA max@ V+ =4.5-5.5V**
	-8mA max @ V+ =3.0-3.6V
	-2mA max @ V+ =2.5-2.7V
Vi Input Voltage	**5.5V**

Notes: we have tested the I2C interface up to 800 kHz with no errors, but it is guaranteed to operate up to 400 kHz.
The SPI interface was tested up to 7.5 MHz with no errors, but it is guaranteed to operate up to 6.0 MHz.

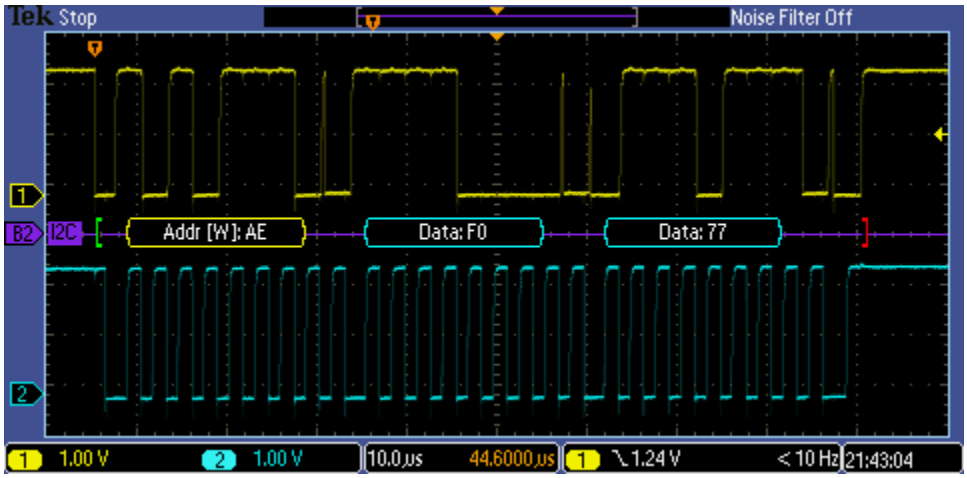
SPI WAVEFORM AT 2.5V

This shows a scope trace on a target board operating at 2.5V through the SPI Isolator and Level Shifter.



I2C WAVEFORM AT 2.5V

This shows a scope trace on a target board operating at 2.5V through the I2C Isolator and Level Shifter.



TECHNICAL SUPPORT

Technical Support for the I2C/SPI Isolator and Level Shifter is available via an email to support@i2ctools.com.

TROUBLESHOOTING

- Make sure you have a supply voltage applied to both sides of the isolator hardware. The minimum voltage is 2.5V. There is an LED on each side of the PCB that should

illuminate when properly connected to the USB-to-I2C hardware and the user target system.

- There are no pull-ups on the USB-to-I2C side of the PCB, so make sure the pull-ups are enabled (jumpers inserted) on the USB-to-I2C hardware.

If all else fails, email a description of the problem you are having to us at support@i2ctools.com.
Note that all technical support requests must begin with an email to this email address.